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Bye Bye, Bycatch

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BYE BYE, BYCATCH!

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Grade Level
7th Grade

Subject Area
Life Science

VA SEA is a collaborative project between the Chesapeake Bay National Estuarine Research Reserve, the Virginia Institute of Marine Science's Marine Advisory Program, and Virginia Sea Grant. The VA SEA project is made possible through funding from the National Estuarine Research Reserve System Science Collaborative, which supports collaborative research that addresses coastal management problems important to the reserves. The Science Collaborative is funded by the National Oceanic and Atmospheric Administration and managed by the University of Michigan Water Center.

Title: *Bye-Bye, Bycatch*

Focus: Using critical thinking skills to better understand how conservation engineering can improve sustainable fisheries

Grade Level: 7th Grade Life Science

VA Science Standards

LS.1 The student will demonstrate an understanding of scientific and engineering practices by
a) asking questions and defining problems
b) planning and carrying out investigations
c) interpreting, analyzing, and evaluating data

LS.7 The student will investigate and understand that adaptations support an organism's survival in an ecosystem. Key ideas include
b) physical and behavioral characteristics enable organisms to survive within a specific ecosystem.

LS.9 The student will investigate and understand that relationships exist between ecosystem dynamics and human activity. Key ideas include
a) changes in habitat can disturb populations
b) disruptions in ecosystems can change species competition

Learning Objectives

- ✓ Students will design and construct a bycatch reduction device
- ✓ Students will assess how efficient their devices were at reducing bycatch while also retaining target catch
- ✓ Students will interpret how the application of their devices may impact a fishery

Total Length of Time Required

Approximately 60 to 80 minutes total; 15 minutes for prep

Key Words & Vocabulary

Bycatch: The incidental capture of those species commercial fisheries did not intentionally mean to catch

Bycatch Reduction Device (BRD)**:** a tool used to separate and/or remove unwanted species from the overall catch

Codend*:* the back end of a trawl where all fish are collected

Commercial fishery**:** The profession of catching fish to sell or trade

Fleet*:* a grouping of ships

Overfishing*:* the act of removing fishes from the sea faster than they can rebuild their population
Sustainability*:* ability to be maintained at a certain rate or level

Target Catch**:** the organisms that a commercial fishery intentionally seeks out and collect

Trawl: A cone-shaped net towed behind a boat

Turtle Excluder Device (TED***)*:** a specific BRD used to keep turtles out of the overall catch

Vessel: a boat, or ship

Background Information

For generations, men and women have set out to sea in hopes of catching prized fish that they could bring back to shore to either sell or trade. Thousands of years of trial and error and technological development has permitted this profession to grow substantially in some regions of the world, going from feeding a village to potentially millions every year. With this rapid expansion in production, the industry of commercial fishing has had to learn some hard truths. **Hard truth #1: the ocean is not infinite.** There are only so many fish in the sea and if the fishers of today want to ensure that fishing will be possible tomorrow, that is to say the industry will remain sustainable, precautions will need to be taken.

Sea life is complex and not every species can respond to impacts of commercial fishing the same. In particular, species that are long-lived and take a long time to mature can be very vulnerable to overfishing as their populations may struggle to keep up with the number of individuals a fishing fleet may continuously remove. Prime examples of such species would be sharks, turtles, and dolphins. In many cases, regulations are set in place to limit the number of vulnerable species annually removed by commercial fishing. However, scientists and fishermen may also look to improve their gear and find ways to better target the species they want and avoid the ones they don't. A common method is to use a bycatch reduction device (BRD). These devices can take a variety of different shapes and sizes, but overall, they are dependent on the biology and behavior of the species they are interested in as well as the gear they use to interact with them. In the Chesapeake Bay, for example, commercial crabbers use something called a terrapin excluder device, or a TED, to prevent diamondback terrapins from entering their pots. These narrow, rectangular devices are attached at the entrance of the traps. While narrow crabs are able to scurry into the pots, the more cylindrical shells of the terrapin prevent them from passing through, similar to how a child's toy teaches them about shapes.

In the 1970s, all five species of sea turtles found in the southeastern waters of the United States were declared endangered and the shrimp fishing fleet was quickly identified as one of the biggest threats to the species. These fishers typically tow a large net behind their ship called a trawl. These large nets are designed to corral shrimp and fish as it sweeps through the water and funnels them into a codend located in the back of the net. Turtles would often be caught in these nets and with no hope of escaping, would ultimately drown. Thus, a team of scientists and fishermen set out to correct this problem and find a solution that could potentially save the turtles. After years of designing and testing devices, they came up with a TED not to dissimilar to the ones used in crab pots. A large grid placed inside the net would stop turtles and other larger animals from entering the codend and instead deflected them towards an escape hatch. Meanwhile, the smaller shrimp that the fishermen were initially targeting were able to pass through the grid without issue and were collected in the codend. The design was simple but incredibly impactful. In some cases, sea turtle bycatch was able to be reduced by upwards of 97% with minimal loss to their target catch. TEDs have become mandated for the fishery and have been

widely regarded as one of the most successful bycatch reduction devices to ever be constructed. They serve as the source of inspiration for this lesson's activity.

Materials & Supplies

- Container (ideally, Tupperware capable of holding 194 fl oz)
- 2- 1lb bag of pony beads
- 1 bag of marbles (ideally, a minimum count of 100)
- (Optional) scale with weigh boat
- BRD kits (1 per group)
    - 1- coffee cup (9oz preferred)
    - 2- index cards
    - 2- toothpicks
    - Tape
    - Scissors

Teacher Preparation & Classroom Setup

This activity works best with groups of 3 students. Each group should be equipped with a BRD kit as the students will look to use these materials to make their devices. Additionally, the instructor should mix two full bags of beads to one bag of marbles into a container. This mixture will serve as the 'sea' in which the devices will be tested.

Procedure

Introduction

- Instructors should load the accompanying PowerPoint presentation and walk-through slides 1-8 as they introduce the lesson (talking points included in notes section)
    - Highlight what bycatch is and how scientists use BRDs to better improve the selectivity of fishing gear

Activity

The goal of the activity is to construct a device that collects the greatest number of beads while also capturing the least number of marbles.

- Students should break off into groups of 3 to 4
    - Each group should have a BRD kit in front of them
- The instructor should then go through slides 9-12 as they explain the background for the activity
- **Before starting the timer** to begin the activity, the instructor should illustrate to the class how the devices will be tested using just a coffee cup.
    - In one motion, going from one end to the other, scoop the cup through the container.
    - Dump out the contents of the cup and count the number of marbles collected as well as the number of beads. If you are using a scale to weight the beads rather than counting them, places all the beads in a weight boat and record the value. Let all the groups no what values you got. ***Their goal is to hopefully get less marbles than the baseline you just performed.***

- Once the values have been announced, *put the beads and marbles back into the container and mix thoroughly*.
- Each group then has 10 minutes to construct their own BRD using the materials found in their kit
  - Throughout the allotted time, each group will have one opportunity to test their device

Before testing the devices (Discussion)

- Have each group present their device and explain their reasoning for their design
  - As each group is explaining their device, the instructor should note any similarities the designs may possess. *Did groups think alike? Were there any differences?*

Testing the devices

- Have each group go one at a time. Ensure that the scoop is in one motion, going from one end to the other, through the container.
- One representative may have to count the marbles while another counts the beads to ensure that the work gets done in a timely manner.
- Once the values have been added up, record them on the board so that the other groups can see.
- Once a group has recorded their values, have them dump the marbles and beads back into the container. Ensure that the 'sea' is thoroughly mixed before the next group goes.

After testing the devices (Discussion)

- Note the recorded values on the board. *Was there a design that did better than the others?* Ask the class: What might have been the reason?
- Note the number of beads the devices were able to collect. *Was there a big reduction when compared to the baseline?* Ask the class: what this could mean for the fishery?
  - Answer: If fishermen were to use these devices, they would have to fish for longer to make up the difference. This could be costly and could increase their chances of catching more bycatch.
  - The instructor should then ask the class: If material and time weren't limited, how would they change their designs?

Conclusion

- The instructor should then go through slides 15-16 as they explain how real TEDs work
  - Highlight how the behavior and biology of the species of interest can greatly impact the success of a BRD.
- Slide 17 provides final thoughts regarding the topic of bycatch and sustainable fisheries.

Assessment

Student assessment should be based on group participation and contributions to class discussion.

References

NOAA shrimp fishery
https://www.fisheries.noaa.gov/species/brown-shrimp

NOAA history of Turtle Excluder Devices
https://www.fisheries.noaa.gov/southeast/bycatch/history-turtle-excluder-devices